

New Features available in AdH Version 4.6

- Added the option to invoke the traditional (classic) Manning's equation to the model, by using the MNC card. The underlying equation that is invoked for the MNC card (Manning's friction) is the same underlying equation that is invoked for the ERH card. This equation is the depth-integrated form of the law-of-the-wall velocity profile, solved for the shear stress. It is theoretically sound over the whole range of depth to roughness ratios. The classic form of Manning's equation, however, is only theoretically sound over a limited range of depth to roughness ratios, and even over this range it is merely an approximation of the theoretical solution. (for more information, please see the following: https://chl.erd.c.dren.mil/adh/documentation/Friction-notes_GaryBrown.pdf) However, the decision to link the MNC card to this more theoretically sound equation has led to a lot of confusion among users, so it was decided to add an option to the model so that the classic form of Manning's equation can be invoked by using the MNC card.
- Added EDO friction to the model (Equivalent Drag due to Obstructions). This is a generic friction card for vegetation and other obstructions. It behaves like the URV card when the vegetation/obstructions are unsubmerged, and behaves like the SAV card when the vegetation/obstructions are submerged.
- An FR SDK card (submerged dike) and FR BRD card (bridge deck) have been added. These are 1D friction terms, used to extract the energy losses associated with local vertical flow separation phenomena that are not directly modeled. They are applied at MDS strings. The FR SDK card simulates the energy losses associated with vertical flow separation behind a submerged dike. The FR BRD card simulates the losses associated with either a partially or a fully submerged bridge deck. The MDS string is defined along the crest of the feature, and then the FR SDK or FR BRD card is invoked for that string.
- The OP DAM card has been added. This optional card can be invoked when performing dam break simulations. It adds extra stability at the wetting front by reversing the sign of the petrov-galerkin temporal terms. Reversing the sign on the temporal terms in the petrov-galerkin terms is mathematically inconsistent but the stability achieved by doing so is dis-proportionately greater than the small error introduced.
- Added Stansby mixing (EEV option 4). Stansby mixing is the same as Smagorinsky, but uses a physically based mixing length rather than the element size to scale the mixing. Also, the coefficient the user applies is actually the minimum allowable value of the eddy viscosity for that material type. These two changes allow the user to specify a rational, physically based means of estimating eddy viscosity, while also exercising explicit control of the minimum value of the eddy viscosity applied to the problem.
- Sediment Transport Changes
 - A change has been made regarding how a cohesive sediment bed is defined, for the purposes of how erosion is calculated. Previously, a sediment bed layer was considered cohesive if the total percent of grains

in the bed that were silts or clays was greater than 10%. In the new version of SEDLIB attached to AdH v4.6, this definition has been changed so that only those grains that are clay sized (≤ 3.9 microns, or 3.9×10^{-6} meters) are considered in the determination of the cohesive behavior of the bed. This is to allow beds that contain silts without any appreciable quantities of clay to behave noncohesively. So, this means that, for AdH 4.6, sediment beds will be considered cohesive only if the fraction of sediment classes with a grain diameter less than or equal to 3.9 microns is greater than 10%.

- The MP BLD card has been added to provide the user the option of adjusting the bedload diffusion. The bedload diffusion is calculated internally, and if the user does not invoke this card the default value is used. If the user does invoke this (optional) card, the bedload diffusion is scaled by the value given on this card.
- The MP LSM card has been added as a means of *approximating* local scour around structures. It is useful for sustaining existing scour holes and/or generating new ones, but since it is only an approximate method it cannot be used to quantify the depth or dimensions of scour. It is just meant to ensure that scour holes don't fill up in the model and alter the bathymetry adjacent to structures.
- The Wilcock method of calculating bedload and suspended load transport has been added as an option.
- The Parker and Klingeman method of calculating the hiding factor has been added as an option.
- Yang total load transport option has been added to the SP NSE options. (i.e. modeled as suspended load with bedload set = -1 (see below)).
- The user can now turn off the calculation of bedload and/or suspended sand load by setting the SP card associated with that mode of transport equal to -1. So, for example, setting SP NSE = -1 will turn off all sand suspended load calculations.
- Added sand infiltration capability by invoking the SP SIF card. This allows sand/silt to infiltrate into gravel substrate (or not) according to the criteria established by Gibson et al.
- Added ability to pass sediment flux through IN/OUT cards (useful for modeling flow diversions).
- Added ability to divert only a portion of the water column to simulate skimming flow and or underflow extraction. This is invoked with the SDV card.
- The information contained in the smr output file has been altered such that it now contains the total mass per unit area that is present in the sediment bed for each sediment class. This information is very useful in investigating sediment fate and performing sediment budgets.